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IDENTIFIERS *Computer Assisted Design; Computer Assisted Manufacturing

ABSTRACT

Individualized, competency-based curriculum materials were developed for a course on Principles of Technology, Units 1-6. New and updated curriculum materials in Drafting and Electronics and the Principles of Technology units were pilot tested in area vocational center settings in Illinois. A computer maintenance program was also developed but not implemented due to lack of enrollment. Progress was made in program articulation between area vocational centers and all feeder schools as well as the community colleges. Task listings for automated manufacturing (electromechanical technicians) were developed; curriculum materials will be further developed during the following year. Conclusions indicated (1) a need for articulation, (2) "turf protection" as a barrier to effective articulation, (3) a need for support from business and industry, and (4) a need for better access to top students. (Appendixes, amounting to over one-half of the report, include results of a survey of student educational and career interests, a sample learning guide for unit 6 of the Principles of Technology program, a summary of the pilot test of Principles of Technology, and task listings for automated manufacturing electro-mechanical technology). (YLB)

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**An Emerging
Technology
Curriculum**

**Illinois
State Board of
Education**

**Adult,
Vocational and
Technical Education**

Final Report

**Education for
Technology Employment
Project**

**Stephenson Area
Career Center
Freeport, IL 61032**

WJW

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**Illinois Education
for Technology
Employment Project**

**Illinois
State Board of
Education**

**Department of Adult,
Vocational and
Technical Education**

Project Staff

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July 1985

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**Stephenson Area
Career Center**

**Jo Daviess-Carroll
Area Vocational
Center**

**Highland Community
College**

An Equal Opportunity/Affirmative Action Employer

a. Final Report Abstract

Official Project Title: High Tam Articulation Model (HiTam) II

Department of Adult, Vocational and Technical Education Funding
Agreement Number: R-99-X-0000-498

Project Director: Roy Monzo

Funded Agency: Stephenson County Education Service Region

Location of Funded Agency: 15 N. Galena Avenue, Freeport, Illinois 61032

Time Period Covered: July 1, 1984 - June 30, 1985

Major Accomplishments of the Project:

1. Student interest surveys with an analysis of the results.
2. Developed individualized competency based curriculum materials for Principles of Technology Units 1-6.
3. Pilot test of Principles of Technology units 1-6 in varied settings with varied students.
4. Implementation of up-dated drafting (CAD) and electronics vocational programs.
5. Curriculum development including task listings for automated manufacturing (electro-mechanical) technician.

Potential Impact on Vocational Education:

The intent of the project is to impact the training of secondary and post-secondary students by providing training for jobs emerging from technology and its applications. The project serves as a model for the development of articulated curricula in several technical areas which will impact the delivery of vocational programming in grades 9-14. Availability of up-to-date training also meets the needs of local industry and impacts local economic development.

Products Delivered: (Indicate titles, types, quantity, recipients and date of delivery)

- Student interest survey results and analysis (see appendix)
- Principles of Technology learning guides, units 1-6
- Preliminary task listings for automated manufacturing (electro mechanical) technician (see appendix).
- Final report, 20 copies-DAVTE 7/31/85
- 30 copies - local dissemination

b. Expenditure of Funds:

All funding targets were essentially as budgeted. The budgeted amount for teacher stipends and teacher substitutes was underspent primarily because personnel was not available as needed or planned due to work loads and time conflicts. Likewise, funds remain unspent in local travel for the same reasons.

c. Paid Participants in Activity:

Charles Endress - Project Coordinator

Wayne Sagstetter - Electronics/Principles of Technology Instructor, SACC

James Stanek - Machine Trades Instructor, SACC

Dan Harm - Principles of Technology Instructor, JDAVC

Michael Kopf - Principles of Technology and Drafting (CAD) Instructor, JDAVC

Roxanne McKenna, Secretary/Bookkeeper, SACC

Sue Meusel, Secretary/Bookkeeper, JDAVC

d. Resources Listing:

- (1) No instructional materials and resources were purchased for the use of the project. Teacher and student resource materials for the Principles of Technology pilot were provided through DAVTE.
- (2) A large group of individuals too numerous to mention, were involved with the project through varied dissemination activities. These included the administrators, counselors, and vocational teachers of Highland Community College, the area vocational centers, and fifteen feeder high schools as follows:

Stephenson Area Career Center

Freeport
Pearl City
Dakota

Lena-Winslow
Orangeville
Shannon

Mount Morris

Jo Daviess-Carroll Area Vocational Center

Stockton
Warren
Elizabeth

Scales Mound
Hanover
Savanna

East Dubuque
Galena

- (3) Specific assistance with the project was provided by the following:

a. Local Administrators

Roy Monzo, Project Director
Director
Stephenson Area Career Center

Larry Zikmund, Director
Jo-Daviess/Carroll Area Vocational Center

Joe Kanosky
Chairman, Vocational and Technical Education
Highland Community College

John Lang
Regional Superintendent
Carroll-Jo Daviess County ESR

Dr. Marvin Maaske
Regional Superintendent
Stephenson County ESR

- b. Illinois State Board of Education, Division of Adult, Vocational and Technical Education

Nona Denton and Sandra Mercer served as the project contact representatives. Dr. John Washburn made a presentation to meetings of Board of Control members of both Area Vocational Centers. Other DAVTE staff members visited our project sites.

- c. Northern Illinois University-the project was provided with technical assistance by the Education for Employment project staff including Dr. Alan Voelker, Dr. Jule Scarborough, and Dr. Alan Robinson.

- d. Eastern Illinois University-personnel training activities involving the majority of our local staffs were coordinated by Dr. Gene Strandberg.

e. Major Accomplishments and Significant Findings of the Project.

1. Project goals and objectives

Objective 1

Further develop and pilot new technology programs in an area vocational center setting. These programs include Principles of Technology, Drafting (CAD), Electronics, and Computer Maintenance.

Pilot field tests of new curriculum materials were done in Drafting (CAD) and Electronics at both the Jo Daviess Area Vocational Center and the Stephenson Area Career Center. Both programs tended to use materials developed for use with specific equipment. While task lists exist, some of the student learning guides in competency-based format are incomplete and will be completed during 85-86. The computer maintenance program was not implemented due to a lack of enrollment.

The pilot test of the Principles of Technology was conducted at both the Jo Daviess and Stephenson Area Vocational Center. Individualized learning guides for units 1-6 were developed at SACC. Students at the Jo Daviess center essentially completed units 1-5 while SACC students completed units 1-6. Both centers found the Principles of Technology project to be exciting and worthwhile. It has been a privilege to be a part of this innovative effort and a more detailed report follows in the appendix.

Objective 2

Develop and implement a regionally based vocational education advisory structure.

This goal was established to promote and assist in the formation of a functional regional vocational education delivery system. It became quite evident early in the project year that because of local "turf" issues, this goal was pre-mature and should not be attempted. The guidelines for regional vocational planning were not fully established and in order for the regional organization to proceed in an orderly manner it was determined that the leadership would need to come from the regional school superintendents.

All of our Education for Technology Employment labor market information, census data, student interest surveys, curriculum materials, etc. will be made available to the regional vocational education planning personnel. For the most part the governance structure for regional planning will involve the same individuals who are involved in the administrative control of both area vocational centers participating in the Education for Employment project, namely Stephenson Area Career Center and Jo-Daviess Carroll Area Vocational Center.

Objective 3

Develop and implement an articulation program between area vocational centers and all feeder schools as well as the community college.

Joint efforts between vocational center and feeder school teachers were encouraged and implemented throughout the project year. JDAVC held regional articulation workshops for teachers in each vocational area. The vocational teachers in the SACC feeder schools were asked to identify and work on specific needs in each vocational area. The business education teachers were most successful in identifying a common task list to be used in all feeder schools to the Stephenson Area Career Center. While progress has been made in program articulation, much remains to be done to truly make it a total reality.

The Northwest Career Guidance Center assisted SACC Student Services in the personnel development and implementation of ICP's in all feeder schools which in turn should serve to further articulation. While the Individualized Career Plans have supposedly been implemented in all feeder schools, some are not yet fully developed.

Cooperative activities continued with Highland Community College throughout the project year. Drafting (CAD), machine trades, auto-body, and cosmetology program instructors, equipment and facilities were jointly shared by SACC/HCC during the 84-85 school terms, Highland Community College also utilized the facilities of the JDAVC and shared an agriculture instructor.

Objective 4

Develop an articulated, competency based secondary/post-secondary curriculum in automated manufacturing and information processing.

SACC electronics and machine trades instructors worked throughout the year reviewing existing programs, identifying competencies for employment, developing task lists, and writing competency-based learning materials for a basic curriculum in automated manufacturing (electro-mechanical technicians). Basic task lists for electronics and machine trades are listed in the appendix, curriculum materials will be further developed and field tested during 1985-86.

We did not work on information processing as a local effort but instead participated in the state ETE curriculum project activities at NIU. These materials will be integrated and field tested as a part of our continuing project activities.

Teachers from our project site also participated in the curriculum efforts in health, drafting (CAD), CAM, and electronics. Available materials will be continually integrated into our vocational programs.

Illinois State Board of Education

Department of Adult, Vocational and Technical Education Research and Development Section

Product Abstract

1. Title of material Principles of Technology Learning Guides: Unit 1 - Force; Unit 2 -Work; Unit 3-Rate; Unit 4-Resistance; Unit 5-Energy; and Unit 6-Power
2. Date material was completed June 30, 1985
3. Please check one: New material ☒ Revised material _____ Field-tested material ☒
4. Originating agency Stephenson Area Career Center
Address Pearl City Road, Freeport, IL Zip Code 61032
5. Name(s) of developer(s) Charles Endress, Education for Technology Employment Project
Address Pearl City Road, Freeport, IL Zip Code 61032
6. Developed pursuant to Contract Number R-99-14-X-0000-498

7. Subject Matter (Check only one according to Department of Education Code):

Code

- | | |
|---|--|
| ☐ 01 Agricultural Education | ☐ 10 Industrial Arts Education |
| ☐ 03 Business and Office Education | ☒ 16 Technical Education |
| ☐ 04 Distributive Education | ☐ 17 Trade and Industrial Education |
| ☐ 07 Health Occupations Education | ☐ 22 Cooperative Education |
| ☐ 09 Home Economics Education | ☐ Career Education |
| | ☐ Other (Specify) _____ |

8. Education Level:

- | | | | |
|--|--------------------------------|--|---|
| ☐ Pre-K Thru 8 | ☐ 7-8 | ☐ 9-10 | ☒ 11-12 |
| ☐ Post-Secondary | ☐ Adult | ☐ Teacher (Pre-service) | |
| ☐ Administrator (Pre-Service) | | ☐ Other (Specify) _____ | |

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|--|---|--|
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| ☐ Teacher Educator | ☐ Guidance Staff | ☐ State Personnel |
| ☐ Other (Specify) _____ | | |

10. Student Type:

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|--|--|--------------------------------------|
| ☒ Regular | ☐ Disadvantaged | ☐ Handicapped |
| ☐ Limited-English Proficiency | ☐ Other (Specify) _____ | |

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☒

understanding

☐ deciding

☐

implementing

15. Are Consultative/Inservice (or staff development) available? Yes _____ No _____

Contact _____

Illinois State Board of Education

Department of Adult, Vocational and Technical Education

Research and Development Section, E-426

100 North First Street

Springfield, IL 62777

(217) 782-4620

16. General Description (State the general objective and suggested method of use. Summarize the content and tell how it is organized. Write the description so that it can be used to promote the material. Continue on back of this sheet or on another sheet if necessary.)

see next page

17. Person Completing this Abstract: Charles R. Endress, Project Coordinator

Full Address _____

Charles R. Endress, Project Coordinator

Stephenson Area Career Center

Pearl City Road

IL

Freeport, IL 61032

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Modern technology with its many rapid changes continually demands that education up-grade its programs to meet these changes. Technicians need to understand the principles upon which their work is based and must be able to adapt to the changing workplace. The Principles of Technology program was developed as a course in applied science to meet these needs. It provides for a unified approach to the study of mechanical, fluid, electrical, and thermal systems.

The Principles of Technology meterology is organized in the traditional lecture-discussion, exercise, and laboratory format. These individualized learning guides were developed as an alternative delivery system for those schools using a self-directed competency-based learning system. While they are only preliminary, they have been used successfully in our pilot test.

With further development, each of the unit learning guides could be refined with additional supportive laboratory and exercise materials as sub-unit learning packets. Learning guides have been developed for each of the first six Principles of Technology units as follows: Unit 1 - Force; Unit 2 - Work; Unit 3 - Rate; Unit 4 - Resistance; Unit 5 Energy; and Unit 6 - Power. Additional units will be developed during the 85-86 second year pilot project. (See appendix B for sample).

3. Major Dissemination Activities

- 3.1 Inasmuch as all activities of the project related to curriculum development all of the outcomes disseminated to date can be classified as general information and report.
- 3.2 The target audiences varied depending upon the nature of the information but included local boards of control, local advisory councils, vocational and academic teachers, administrators, guidance counselors, parents, students, general public, and regional vocational administrators.
- 3.3 All of the activities were informational in nature and were intended to create an awareness of the project and its outcomes. However, specific information was given to local boards of control to reach levels of understanding, decision, and implementation relative to pilot and curriculum modifications for the 85-86 school year.
- 3.4 The major strategy for dissemination consisted of oral presentations at appropriate meetings of target audiences.
- 3.5 The following specific activities should be identified.
 - a. Local Board of Control - as least bi-monthly.
 - b. Local Advisory Committees - the general advisory committee and student personnel advisory committees were up-dated on a regular basis. Specific advisory committees were informed periodically as appropriate.
 - c. A general presentation was made by Mr. Charles Endress to the SACC Philosophy and Goals Committee on 3-18-85.

d. Mr. Dan Harms received the Principles of Technology program at several Jo Daviess County Curriculum workshops and with several local Boards of Education.

3.6 Inasmuch as activities were informational in nature and aimed at creating an awareness, no formal follow-up and evaluation activities were used. Informal conversations with participants and their consequent statements and actions would indicate the dissemination activities were successful at least on the awareness level.

4. Staff Development

One planned in-service session was held for orientation of the local project staff. All other staff development activities occurred within the framework of the staff development project conducted by Eastern Illinois University. The staffs of the Stephenson Area Career Center and the Jo-Daviess Carroll Area Vocational Center made extensive use of these opportunities. Vi Bangasser of Highland Community College took part in an advanced computer data base management seminar. Charles Endress and Dan Harms attended the Principles of Technology orientation seminar, the second consortium meeting, and the final review/consortium meeting for pilot teachers.

Staff members from SACC and JDAVC participated in the Education for Technology curriculum development activities at Northern Illinois University in the areas of drafting (CAD), health care, business, and machine trades. Other staff members took part in advanced auto unibody repair, auto mechanics, and computer training.

5. Publicity

Because the majority of the project activities were developmental in nature, publicity was limited and essentially concurrent with dissemination activities about the Education for Technology Employment project itself. There were local news reports of meetings and other activities containing bits of information relative to the project. With implementation, an effort should be made to secure adequate publicity.

f. Problems

There have been few problems in terms of project goals and timelines. All of the curriculum activities will be incorporated in future programming for emerging vocational programs impacted by technology if such programs are implemented.

We have had excellent cooperation from members of the project staff and vocational educators from all feeder schools. As we have progressed with the project, it has become apparent that extensive released time from regular employment and the use of substitutes creates problems in the continuity of regular instructional programs. Both area vocational centers had difficulty in securing qualified electronics instructors willing to implement program change.

Local "turf" issues continue to hinder the development, implementation, and articulation of new vocational programs as well as the maintenance of existing ones in the area vocational centers and feeder schools. With increased competition for reduced vocational funding, maintenance of existing programs even becomes more difficult. Articulation with the community college in terms of established programs does not seem to present a problem.

g. **Summation of Evaluation Data Collected**

Empirical evaluation data was not collected and the project proposal did not contemplate collecting any. The evaluation component of this project was intended to be a management tool, used to keep the project on task, on time, and within the budget. During the planning and proposal phase of the project, considerable effort was put into planning an evaluation component that would keep the project "on track" without using a large portion of the budget.

The management process used was to use the CIPP model, and then ask appropriate key questions for evaluation. The key questions developed in the proposal evaluation section and the activity evaluation criteria section proved adequate to the needs of the project. No significant management problems were encountered, target dates were met, and the costs were all at or below budgeted amounts.

The Principles of Technology pilot program has its own evaluation component. A summary of the data is included in that report. (See appendix C). The procedure includes student questionnaires, teacher questionnaires, a teacher product checklist, as well as student pre and post test scores.

H. Statement of Impact:

The intent of the project was to identify the training needs of secondary students in Stephenson, Carroll, and Jo Daviess counties required to provide technically trained people for "high tech" industries. This in turn directly impacts the traditional vocational education curriculum structure. Students will be required to complete basic academic skill training integrated with their vocational courses to provide for a technology curriculum. This curriculum should begin at the ninth grade level (or perhaps earlier) and would continue through the fourteenth grade level at the community college.

The technology curriculum should break the traditional separation of academic and vocational courses. The project already has had sufficient dissemination to verify the fact that academic and some traditional vocational teachers as well entrenched and true educational reform will be more difficult than originally perceived.

While the project directly impacts the training of the high school students interested in a technological career, it also impacts the curriculum structure of feeder schools, the area vocational centers, and the community colleges. Consequently, articulation and cooperation among all educational agencies is an absolute essential. Local "turf" issues have already immersed as a primary obstacle to change but progress has already been made by identifying such issues.

Within the Education for Employment project planning already established, changes were implemented in the drafting and electronics curricula during 84-85. Planning and development continues in the areas of information processing and automated manufacturing. Students ultimately should leave the technology curriculum with broad based academic training and specific technical training including electronics, hydraulics, pneumatics, optics, and microprocessors.

It is obvious that the general public does not fully comprehend the rapid changes in business/industry that have already occurred due to the applications of technology. Cooperation between business/industry and education has become critical to providing for a technically trained labor force. The Education for Employment project offers a greater opportunity for business/industry involvement in the total reform of vocational programs.

The general structure of the project involving the Stephenson Area Career Center, the Jo-Daviess Carroll Area Vocational Center and Highland Community College along with two Education Service Region Superintendents will continue to serve as thrust for broad regional vocational planning.

i. Conclusions and Recommendations

The conclusions which follow are based solely on our experiences and observations to date. For the most part they continue to support previous conclusions.

1. Teamwork between institutions through articulated programs will provide for better quality programs resulting in better qualified graduates ready to meet the needs demanded by new and expanding technology. Articulation will provide incentives for secondary voc-tech students to aspire to further training at the community college level leading to increased competencies and better job opportunities.
2. "Turf protection" remains as the single most barrier to effective articulation. An open competitive environment between secondary, area vocational centers, and community colleges over students and programs directly impacts on program success, use of resources, and community-business and industry support.
3. The need exists for support from business and industry. In an era when education is seeking for and badly needs business and industry support, it must be able to demonstrate quality programs and effective use of resources. Industry appears to be eager to work in cooperative educational ventures.

4. Access to students continues to be a problem in education for technology programs when geared to upper level secondary students. With the emphasis on increased graduation requirements and more academic coursework, it becomes virtually impossible to reach top students because of scheduling conflicts between academic and vocational coursework in traditional programming. New and innovative ways will need to be found to schedule students or meet graduation requirements.
5. The relationships between emerging technology and educational needs have not yet been clearly identified. The differences and issues relating to training for jobs in high technology versus for employment in emerging jobs utilizing high technology applications must continue to be clarified and defined.
6. The Principles of Technology instructional program is an effective functional course in applied science. While useful to all vocational students, it is most appropriate and essential for average or better students training for jobs demanding a broad understanding of technical concepts and energy systems. It is probably best offered as a separate course prior to enrollment in technical vocational programs with basic algebra as a desirable pre-requisite.

7. Attempts to reform traditional education patterns continues to meet with considerable opposition from well entrenched forces. Tradition, prejudice, and inflexibility continue to impact vocational education. An extensive program of public relations and staff in-service remains an absolute essential for future project activities.

APPENDICES

Appendix A - Student Interest Survey Results

**Appendix B - Principles of Technology
Sample Learning Guide
Unit 6 - Power**

Appendix C - Principles of Technology Pilot Summary

**Appendix D - Task Listings - Automated Manufacturing
(Electro-Mechanical Technology)**

APPENDIX A

STUDENT INTEREST SURVEY RESULTS

Education for Technology Employment
Jo Daviess Carroll Area Vocational Center
Stephenson Area Career Center

HIGH SCHOOL STUDENT CAREER AND EDUCATIONAL INTERESTS

Nearly 800 high school students, a sample of slightly less than 20% of the students enrolled primarily in Jo Daviess and Stephenson County high schools, were surveyed to determine their educational and career interests. The respondents, selected on a random sampling procedure, included students from fifteen high schools.

These schools included Savanna, East Dubuque, Galena, Elizabeth, Hanover, Warren, Scales Mound, Stockton, and Shannon in Jo Daviess-Carroll Counties. Stephenson County schools included Freeport, Aquin, Pearl City, Dakota, Lena-Winslow, and Orangeville. Almost one-third of the sample came from Freeport High School.

The students were not identified by general academic ability prior to being surveyed. The students were evenly distributed by sex with 50.1% of the respondents indicating "male" and 49.5 of the respondents indicating "female". Approximately .4% did not indicate their gender on the questionnaire (see Table 3-1).

As can be observed from the data in Table 3-2, student respondents were rather evenly distributed by class with the least number coming from the sophomore class. The responses by class included 27.4% freshmen, 19.8% sophomores, 25.3% juniors, and 27.6% seniors.

High School Student Programs

Table 3-1: High School Student Respondents Described by Sex

Student's Sex	N	%
Male	384	50.1
Female	379	49.5
No Response	3	.4

Table 3-2: High School Student Respondents Described by Class in School

Student's Class	N	%
Freshman	209	27.4
Sophomore	151	19.8
Junior	193	25.3
Senior	211	27.6

When asked how long they had lived in the northwestern Illinois area, 79.3% of the students indicated that they had lived in the area for their entire life.

Over half (58%) of the students reported that their family income was between \$20,000 and \$50,000 per year. However, 11.7% of the students did not indicate their family income.

High School Student Programs

The students were asked to indicate the program that best described the one they were presently pursuing in school. The students indicated that they were in a 'general education program' (38.7%), 'college preparatory program' (50.5%), and 'vocational education program' (10.8%) (see Table 3-3).

Table 3-3: High School Program Being Pursued by High School Students

Program Pursuing	N	%
General Education	295	38.7
College Preparation	385	50.5
Vocational Education	82	10.8

Table 3-4 summarizes the responses of the high school students concerning their past, present and future participation in vocational education courses. Each of the five occupational areas identified by ISBE/DAVTE was listed with the addition of 'computer science.' Table 3-4 reveals that future interest is the strongest for computer science courses. The other occupational areas show decreased future plans for enrollment for most traditional vocational areas.

Table 3-4: Percent of High School Students Indicating, Past, Current and/or Future Participation in Vocational Education Courses

Vocational Courses	Past %	Current %	Future %
Business Education	45.6	35.0	26.9
Computer Science	19.5	17.8	35.1
Health Occupations	10.8	4.6	16.3
Home Economics	34.9	14.8	14.4
Industrial Education	30.5	14.2	14.5
Agriculture	11.0	8.5	13.4

Students' Post High School Plans

When asked about plans following high school, 33.6% of the students indicated that they would be attending a four-year college, an additional 11.1% indicated that they would be attending a junior community college and then a senior college, and 12.8% indicated that they would be attending a junior college. Thus, 57.5% of the students indicate that they planned to pursue some type of post secondary education after they complete high school (see Table 3-5).

The students were asked how sure they were of their post high school plans. Most students indicated that they were 'definitely sure' (30.5%) or 'fairly sure' (55.1%), while 14.4% indicated that they were 'not at all sure' about their plans (see Table 3-6).

The responses for the post high school plans were not crosstabulated with the sureness of plans. However, similar studies suggest that the college bound students are somewhat more certain of their post high school plans than are the non-college bound students.

Table 3-5: High School Students' Post High School Plans

Post High School Plans	N	%
Homemaker	7	.9
Part-time work	15	2.0
Full-time work	112	14.6
Attend technical/trade school	45	5.9
Attend 2-year college	98	12.8
Attend 4-year college	257	33.6
Attend 2-year college then attend 4-year college	85	11.1
Join military	59	7.7
Not decided	88	11.5

Table 3-6: High School Students' Sureness of Post High School Plans

Sureness of Plans	N	%
Definitely sure	231	30.5
Fairly sure	418	55.1
Not at all sure	109	14.4

Considering the needs for job skill training, the data presented in Table 3-7 show that nearly 17% of the students plan to enter the workforce immediately after high school (full-time or part-time work). An additional 18.7% of the students indicate that they are planning to pursue post high school training at a trade school or junior/community college. These percentages suggest that effective vocational and technical education programs need to be readily accessible to the students.

Student Career Interests

The students were asked to indicate their first, second and third career choices (see Table 3-7). When reviewing the responses for the first career choice, computer programmer was the most popular choice with 45 responses (6.5%) with accountant having 38 responses (5.5%), beautician then followed with 35 responses (5.0%), and engineering with 34 responses (4.9%). Other very popular responses included secretary 33 (4.8%), lawyer 29 (4.2%), teacher 26 (3.8%), farmer 25 (3.6%), business manager 22 (3.2%), and military 17 (2.4%). These were the most popular occupations identified as the first choice of the students. It should be noted that engineering was a very popular career choice as determined by combining all of the engineering careers. A total of 34 students indicated engineering as their first career preference (4.9%).

Table 3-7: High School Students' Career Interest Ranked by Frequency of Response

Cover Area	N	%
Computer Programmer	45	6.5
Accountant	38	5.5
Beautician	35	5.0
Engineering *	34	4.9
Secretary and clerk	33	4.8
Lawyer	29	4.2
Teacher	26	3.8
Farmer	25	3.6
Business Manager	22	3.2
Military	17	2.4
Veterinarian	13	1.9

*all engineering careers combined

The second choice for career did not have as many occupations with a large number of responses. The most popular second choice was engineering 5.4%, next was accounting 4.7%, followed by teaching 3.4%, farming 3.3%, with computer programmer selected by 3.0% students. Four occupations were indicated as the third choice by a number of students; those were engineering, teaching, secretarial, and computer programmer.

If students' first, second, and third career choices are presented by occupational area, it can be noted that the 'college' percentage drops significantly for the first choice to the third choice.

While an in-depth analysis of a correlation between parents' careers and the occupational preference of the students is not presented here, it should be noted that the major career areas for the father, as indicated by the students, included factory worker, farmer, business manager, carpentry and construction, machinist, and truck driver. The major careers for mothers, as indicated by the students, included homemaker, registered nurse, secretary, and factory worker.

High School Students' Current Employment

The students were asked if they were currently employed for pay. Table 3-8 shows that 307 (40.4%) students indicated that they were employed. Of those who indicated that they were employed, 64.8% worked 11 hours or more per week.

Nearly 13% of the students who were employed indicated that their employment was part of a cooperative vocational education program (see Table 3-8). Slightly over 18% of the students indicated that their current employment was related to their major career interest. One-third of the cooperative vocational education students indicated that their employment was related to their major career interest as compared to 15.4% of the working students who were not enrolled in cooperative education.

Table 3-8: High School Students' Responses to Questions Regarding Their Employment

Currently employed	N	%
Yes	307	40.4
No	452	59.6
Hours per week	N	%
Less than 5	38	12.4
6-10	70	22.8
11-15	63	20.5
16-20	67	21.8
More than 21	69	22.5
Is your employment part of a cooperative education program?	N	%
Yes	39	12.6
No	219	72.3
Not sure	12	4.0

High School Students' Opinions of School Programs

The students were asked how adequate their school programs were for college bound and noncollege bound students. The vast majority of the students indicated that their school programs were either 'good' or 'very good' for students that were college bound (84.8%). When asked about the adequacy of school programs for noncollege bound students, 68.0% of the students indicated that they felt that their programs were 'very good' or 'good.'

When asked about the adequacy of career guidance programs for college bound students, 77% of the students indicated that they were 'very good' or 'good.' When asked about the adequacy of career guidance for the noncollege bound students, 65.2% of the students indicated that they were 'very good' or 'good' (see Table 3-9).

Table 3-9: High School Students' Opinions of High School Programs and Career Counseling

High School Educational Programs	Very Good	Good	Fair	Not Very Good
students planning to attend college	15.4	59.8	20.8	4.1
students planning to enter the workforce	14.0	52.5	27.1	6.4
High School Career Guidance and Counseling				
students planning to attend college	32.7	50.9	12.0	4.3
students planning to enter the workforce	19.3	53.6	21.2	5.8

The students were also asked to indicate the extent to which they thought that high school should prepare students for work and the extent to which their high school does prepare students for entry into the workforce. In Table 3-10, their responses to these two questions are reported. These results show 95.2% of the students 'strongly agree' or 'agree' that high school should prepare students for entry into the workforce while 85.3% of the students 'strongly agreed' or 'agreed' that their school was preparing them to enter the world of work. The distribution of responses shows the curve skewed toward 'strongly agree' for the 'should' question and toward 'agree' for the 'does' question.

Table 3-10: High School Students' Opinions of the Place of Preparation for Work in High School

Question	Strongly Agree %	Agree %	Disagree %	Strongly Disagree %
To what extent do you agree that high school should prepare you for entry into the workforce?	40.6	54.6	3.6	1.2
To what extent do you agree that your high school experience is preparing you to enter the world of work?	11.9	73.4	12.1	2.5

The responses to these two questions were not evaluated by high school class. Other studies suggest that more seniors would 'strongly agree' that high school should be preparing student for entry into the workforce than did students in the lower grades. On the other hand, fewer seniors would agree that their high school experience prepared them for the world of work.

The students were further asked if they knew the types of skills and education required for entry into their first career choice. The data provided in Table 3-11 show that 56.7% of the students responded 'yes' to this question. Approximately one-third of the students do not know what is required to prepare to enter their major career choice. This may suggest a need for more career counseling and/or occupational information programs.

Table 3-11: High School Student Responses to Questions Regarding Requirements for Entry into Career Areas of Interest to Them

Question	Responses					
	Yes		No		Not Sure	
	N	%	N	%	N	%
Do you know the types of skills and education required to enter the career area of your interest?	424	56.7	76	10.2	248	32.4
Are there essential courses for preparing you for your future career that are not offered at your high school?	148	19.7	301	40.1	301	40.1

The students were also asked if there were essential courses to prepare them for their career choice that were not offered at their high school. The data presented in Table 3-11 indicates that almost one-fifth of the students felt that there were courses that they needed to prepare for their major career area which were not available at their high schools.

3.7. Students' High Tech Occupational Training Interests

The students were asked to indicate the extent to which they would be interested in course work in various high technology occupations. The results are reported in Table 3-12.

Table 3-12: High School Student Interest in New and Emerging Career Areas

Career Areas	Degree of Interest			
	Definite %	Some %	None %	No Basis for Responding %
Fiber Optics	3.2	15.2	58.5	23.1
Laser Technology	13.5	33.9	40.3	12.4
Ultrasonic Medical Technology	7.0	29.3	49.4	14.3
Computer Repair	13.4	31.2	46.7	8.7
Computer Programming	29.2	43.9	20.7	6.2
Industrial Robotics	15.5	31.5	42.3	10.7
Energy Utilization/ Conservation	6.3	26.8	54.2	12.6
Aerospace Technology	9.9	25.3	49.8	15.0
Computer Assisted Design	18.4	38.4	35.5	7.7
Computer Assisted Manufacturing	14.0	29.9	45.6	10.5
Information/Word Processing	19.0	39.9	32.5	8.6
Hydroponic Food Production	4.9	17.3	64.0	13.8
Genetic Engineering	8.4	23.6	55.4	12.7
Nuclear Medical Technology	8.3	22.2	56.2	13.3

The responses to these questions suggest that there is some definite interest in various high technology occupations. This is especially true for occupations related to computers (programming, repair, design, manufacturing, word processing, robotics, etc.). It should be noted that the immediate area

served by the school districts in the Highland Community College area contains few businesses/industries as yet that utilize high technology. A significant number of students listed no basis for responding.

3.8. Program Delivery System Structure

The students were asked to indicate their preference for structuring the system for the delivery of career/vocational education services in the area served by Highland Community College. Their responses for the four options presented were: 'all programs in each high school' (20.2%), 'having the programs in a few specifically designated high schools' (13.5%), 'establishing an area vocational center' (35.4%), 'and expanding access to Highland College' (30.9%) (see Table 3-13).

Table 3-13: High School Students' Opinions Regarding the 'Best' Educational Arrangements for Providing Career Related Instruction in the Northwestern Illinois Area

Arrangements for Program Delivery	N	%
Area vocational center	249	35.4
Community College	217	30.9
In individual high schools	142	20.2
Satellite	95	13.5

As these data show, the students were almost evenly divided with no clear preference for arrangements for providing career-related instruction in the area served by Highland Community College.

In addition to the question about arrangements for providing instruction, the students were asked if they would be willing to travel to a facility away from their high school to participate in career related instruction. The majority of the students indicated that they would be willing to travel (67.0%) or that they were not sure if they would be willing to travel (24.5%). Less than 10% of the students indicated that they would not be willing to travel to another site for career-related instruction (see Table 3-14).

Table 3-14: High School Students' Willingness to Travel to Outside Facilities for Career Related Instruction

	Yes %	No %	Not Sure %
Willingness to travel	67.0	8.5	24.5

Students willingness to travel is not reported by grade level. The willingness to travel generally increases with each successive grade level. This may suggest that the students have not been able to take the courses that they want from their individual high schools and are more willing to travel to get what they want. In addition, other studies have shown that a higher percentage of vocational education students report they are willing to travel than college prep or general education students.

Table 3-15 presents the maximum time the students report that they would be willing to travel on the school bus to another facility for career-related instruction. The students appear to prefer to travel thirty minutes or less.

Table 3-15: High School Student Maximum Travel Time to an Outside Facility for Career Related Instruction

Maximum travel time	All Students %
15 minutes	12.6
20 minutes	17.9
25 minutes	10.4
30 minutes	29.8
35 minutes	3.5
40 minutes	25.8

Summary

High school students who responded to this survey have developed a clear and significant interest in high technology and other emerging careers. These students show a fairly consistent preference for gaining training in their high school, training that prepares them for either further training or job entry level skills. Clearly the challenges of providing relevant vocational education programs face the administrator in this area. A search for alternate ways of delivering programs seems necessary.

APPENDIX B

Principles of Technology Learning Guide Unit 6 Power

The following learning guides are also available:

Unit 1 - Force

Unit 2 - Work

Unit 3 - Rate

Unit 4 - Resistance

Unit 5 - Energy



PRELIMINARY DRAFT ONLY

PRINCIPLES OF TECHNOLOGY

Unit 6 POWER

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Education for Technology Project

STEPHENSON AREA CAREER CENTER

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A LEARNING GUIDE

TASK

Understand POWER and its applications to mechanical, fluid, electrical, and thermal systems.

PURPOSE



LEARNING CONTRACT

1 STUDENT DATA

NAME _____

SOCIAL SECURITY NUMBER _____

LENGTH OF CONTRACT (NORMAL TIME IN HOURS) _____

2 TERMINAL PERFORMANCE OBJECTIVE

When you finish the unit on "Power" you should be able to define or describe power in emchanical, fluid, electrical, and thermal systems; solve problem applications of power in each system; and identify units of measurement for power in each system.

2a Micro-Performance Objective(s)

1. Understand POWER in mechanical systems.
2. Understand POWER in fluid systems.
3. Understand POWER in electrical systems.
4. Understand POWER in thermal systems.
5. Review concept of POWER and its applications to each energy system.

3 AGREEMENT

I, _____ agree to complete the above stated terminal performance requirement within _____ to _____. I further recognize that the conditions of the contract (performance and time agreement) report my ability to perform the requirements of the occupation and record my progress.

Student's Signature

Instructor's Signature
(verifies competency)

MICRO - PERFORMANCE OBJECTIVE #1

Understand Power in Mechanical Systems

LEARNING STEPS

1. Assessment of prior mastery
2. Become familiar with definition of power in each energy system.
3. Define power in linear and rotational mechanical systems; identify units of power; solve power equations; define efficiency in power terminology.
4. Solve for an unknown using the equations for power in mechanical systems.
5. Measure power in mechanical systems.
6. Review
7. Proceed to MPO #2

RESOURCES

1. See instructor for pre-test
2.
 - a. Read text pp. 1-9
 - b. View video: "Overview: Power"
3.
 - a. Read text pp. 11-18
 - b. View video: "Power in Mechanical Systems"
 - c. Read text pp. 18-25
 - d. Complete student exercises on pp. 26-7 in text. Obtain copies from your instructor.
4.
 - a. Read text pp. 29-35
 - b. Solve problems pp. 30-5 in textbook using separate paper.
5.
 - a. Read pp. 38-9 in textbook and review experiment 6M1 on pp. 40-4.
 - b. Use information to solve problems on supplemental lab data sheet 6M1.
 - c. Read pp. 46-7 in textbook and review experiment 6M2 pp. 48-51. Use information on supplemental lab data sheet and complete this sheet.
6. Complete review activity sheet 6M1 in this learning guide. Review video: "Power in Mechanical Systems"

STUDENT EXERCISES

1. Which of the following formulas is an incorrect equation for calculating power? Circle the correct letter.
 - a. $P = \frac{W}{t}$
 - b. $P = T \times \omega$
 - c. $P = \frac{F \times v}{t}$
 - d. $P = \frac{F \times D}{t}$
2. An elevator weighs 3500 lb. It is pulled upward a distance of 30 feet, at constant speed, in 10 seconds.
 - a. Determine the work done by the cable that lifts the elevator. Use the formula, $W = F \times D$.
 - b. Determine the upward speed of the elevator.
 - c. Determine the elevator power in units of ft·lb/sec. Use the equation, $P = W/t$.
 - d. Determine the elevator power in units of ft·lb/sec. Use the equation, $P = F \times v$.
 - e. Compare answers to "c" and "d." Are they equal? Should they be?
 - f. Convert the elevator power in ft·lb/sec to horsepower.
3. A force of 25 N is needed to keep a piston moving at a speed of 0.5 m/sec.
 - a. What is the piston power in (N·m)/sec?
 - b. What is the piston power in watts?
 - c. What is the piston power in joules/sec?
 - d. How much work (in joules) is done on the piston in 2 seconds?
4. A 5-hp electric motor has a shaft torque of 0.5 ft·lb and a rotational speed of 800 rpm. What's its shaft horsepower?
5. What is the efficiency of a winch/block and tackle system that requires 1000 watts of input power to raise a 100-kg mass a distance of one meter in one second?

6. A car has a flat tire. The driver jacks up the car to change the tire. In the process, the hand jack raises the back of the car 0.5 ft off the ground--while lifting 1000 lb.
- How much power is required if the car is raised in 10 seconds?
 - How much power is required if the car is raised in 1 minute?
 - How much work is done in Part "a"?
 - How much work is done in Part "b"?
7. Unifying equations for power in linear mechanical systems are shown in Column A. What are the corresponding unifying equations for power in rotational mechanical systems? Write your answers in Column B.

Column A

$$P = \frac{W}{t}$$

$$P = \frac{F \times D}{t}$$

$$P = F \times v$$

Column B

$$P = \underline{\hspace{2cm}} .$$

$$P = \underline{\hspace{2cm}} .$$

$$P = \underline{\hspace{2cm}} .$$

Principles of Technology
Review Activity Sheet 6M1

1. Define power in a linear mechanical system in two different ways.

- a. _____
- b. _____

2. Define power in a rotational mechanical system in the same equivalent ways.

- a. _____
- b. _____

3. Identify at least four units for measuring power in mechanical systems.

4. How are power and efficiency related? _____

5. Solve the following problems:

a. If an 18 HP engine runs a hoist that can raise a load of 29400 N. a distance of 8 m. in 20 sec., find the efficiency of the engine and hoist system.

b. What is the power output of a machine that lifts 3920 N. to a height of 20 meters in 30 sec.?

c. A motor turns at 40 rev/s and supplies a torque of 75 N·m. What horsepower does it deliver?

6. Identify workplace applications where technicians measure or control mechanical power.

Principles of Technology
Supplemental Lab Data Sheet
6M1

Solve the following problems:

1. A hoist motor supplied with 240 v. requires 12 A. to lift 2000 lb. at a rate of 25 ft./min. Determine the power input, power output, and the efficiency of the system.
2. An electric motor with 95% efficiency uses 20 A. when connected to a 110 v. circuit. What is the H.P. output of the motor?

Principles Technology
Supplemental L. Data Sheet 6M2

DATA TABLE 1

Mass (m) of Flywheel #1 (kilograms)	Radius (r) of Flywheel #1 (meters)
<u>2</u> kg	<u>.12</u> m

DATA TABLE 2

Trial	Flywheel rpm (initial speed)	Angular Speed (rad/sec)	Calculated E_k of Flywheel (N·m or J)	Δt (sec)	Avg Power Used to Stop Flywheel $P_{avg} = \frac{E_k}{\Delta t}$ in $\frac{\text{joules}}{\text{sec}}$	Total Weight (gms)
1	750 rpm			22		
2	750 rpm			12		
3	750 rpm			8		
4	500 rpm			16		
5	300 rpm			10		

WRAP-UP

BEST COPY AVAILABLE

MICRO - PERFORMANCE OBJECTIVE #2

Understand Power in Fluid Systems

LEARNING STEPS

1. Define power in a fluid system; solve fluid power equations; understand how power is measured and controlled in fluid systems.
2. Solve for an unknown in the fluid power equation.
3. Measure power in fluid systems
4. Review
5. Proceed to MPO #3

RESOURCES

1.
 - a. Read text pp. 57-62
 - b. View video: "Power in Fluid Systems"
 - c. Read text pp. 63-69
 - d. Complete student exercises on p. 70 in textbook. Obtain copies from your instructor.
2.
 - a. Read text pp. 71-78
 - b. Solve problems on pp. 73-8 in textbook using separate paper.
3. Review discussion pages for labs 6F1 and 6F2 on pp. 79-81 and 87-9. Lab activities will be omitted at this time.
4. Complete review activity sheet 6F1 in this learning guide. Review video: "Power in Fluid Systems"

STUDENT EXERCISES

1. Which of the following formulas is a correct formula for calculating fluid power? (Circle the appropriate letters.)
 - a. $P = W/t$
 - b. $P = \Delta p \times Q_v$
 - c. $P = \frac{\Delta p \times V}{t}$
 - d. $P = p \times \Delta V$
 - e. $P = \frac{F \times V}{t}$
 - f. $P = \frac{p \times Q_v}{t}$
 2. The two unifying equations for calculating power are:
Power = Work done divided by _____.
Power = _____ times rate.
(Complete the equations.)
 3. A laser cooling system requires a pump that develops a pressure difference (Δp) of 35 psi (gage) and a flow rate (Q_v) of 1.5 ft³/min.
 - a. Calculate the fluid power developed in ft·lb/sec.
 - b. Calculate the fluid power developed in hp.
 4. A one-horsepower pump produces a pressure difference (Δp) of 10⁵ N/m². What is the flow rate (Q_v) in m³/sec developed by the pump?
 5. A pump has an input torque of 5 ft·lb and a rotational rate of 400 rpm. It is 90% efficient and produces an output pressure of 15 psi (gage). What is the flow rate out of the pump? (Give your answer in ft³/sec.)
 6. A hydraulic cylinder produces a power of 7500 watts with an output force of 2000 N. The area of the cylinder is 40 cm². Find the following:
 - a. Speed of the piston in meters/second.
 - b. Pressure difference across the piston in N/m².
 - c. Fluid flow rate into the cylinder in m³/second.
 7. A fluid delivery system is 50% efficient. What happens to the other 50% of the power?
-

Principles of Technology
Review Activity Sheet 6F1

1. Explain how power in a fluid system may be defined as Work/Time.

2. Explain how power in a fluid system may also be defined or described as a "Force" x Rate.

3. Solve the following problems: Hint: 1 HP = 746 watts = 746 N·m/sec

a. What H.P. is required to force 200 ft.³ of water per minute into a water main at a pressure of 25 lb./in.²?

b. What power is required to force 8 m.³ of water per minute into a water main at a pressure of 220 kPa? (1 Pa = N/m²)

4. Identify workplace applications where technicians measure or control fluid power.

MICRO - PERFORMANCE OBJECTIVE #3

Understand Power in Electrical Systems

LEARNING STEPS

1. Define power in an electrical system; define units for electrical power; solve electrical power equations; understand how power is measured and controlled in electrical systems.
2. Compute an electric bill; solve for an unknown using the equation for power in an electrical system
3. Measure power in an electrical system
4. Review
5. Proceed to MPO #4

RESOURCES

1.
 - a. Read text pp. 99-103
 - b. View video: "Power in Electrical Systems"
 - c. Read text pp. 103-108
2.
 - a. Read textbook pp. 111-18
 - b. Solve problems on pp. 114-18 in textbook using separate paper
3.
 - a. Read text pp. 120-2. Use this information to solve problems on supplemental lab data sheet 6E1.
 - b. Read text pp. 127-129. Review procedures on pp. 130-3 and ask instructor for specific instructions for lab 6E2
4. Complete review activity sheet 6E1 in this learning guide. Review video: "Power in Electrical Systems"

STUDENT EXERCISES

1. Examine the equations listed below. Identify those that can be used to calculate electrical power. (Circle the correct letters.)
 - a. $P = \Delta V \times q$
 - b. $P = \frac{(\Delta V)^2}{R}$
 - c. $P = I^2 R$
 - d. $P = \frac{\Delta V \times q}{t}$
 - e. $P = \Delta V / I$
 - f. $P = W \times t$
 - g. $P = (\Delta V) \times I$
 - h. $P = I \times R$
2. One watt of power is equal to "one volt times one ampere," or 1 V·A. One watt of power is also equal to which of the following? (Circle the correct letters.)
 - a. $1 \text{ V}^2/\Omega^2$
 - b. $1 \text{ A}^2 \cdot \Omega$
 - c. joule/sec
 - d. joule/sec
 - e. $1.34 \times 10^{-3} \text{ hp}$
 - f. 1/1000 of a kilowatt
 - g. one cal/sec
 - h. one newton-meter
3. An electric toaster requires a voltage of 110 V and a current of 9.09 A. What is its power?
4. A 100-watt light bulb operates on 110 V. How much current does the light bulb draw?
5. What is the maximum current that can flow through a resistor rated at 50 ohms and 100 watts?
6. What is the maximum voltage drop that can be applied across a resistor rated at 100 ohms and 2 watts?
7. If a 5-hp motor operates for 20 hours, how much electrical energy is consumed?

STUDENT CHALLENGE

8. A pump must deliver a pressure of 50 psig and a flow rate of 20 gal/min. The efficiency of the pump is 92%. The pump is powered by an electric motor operating on 120 V. The motor is 90% efficient. How much current does the motor draw?
9. An electric heating element is immersed in a plastic cup that contains one-half liter of water. The heating element operates on 20 V and 5 A. How long will it take for the temperature of the water to increase by 10 degrees centigrade?

**Principles of Technology
Review Activity Sheet 6E1**

1. Explain how power in an electrical system may be defined as Work/Time.

2. Explain why power in an electrical system can also be described as a "force" times a rate.

3. Define the units of power in SI and English system that are used in electricity.

4. Solve the following problems:

a. What power is supplied to a 12 hp. motor when it is delivering its full rated output if the motor has an efficiency of 90%?

b. An electric motor draws 5 A. from a 110 v. line. Determine the power input?

5. List workplace applications where technicians measure or control power in electrical systems:

Principles of Technology
Supplemental Lab Data Sheet
6E1

Solve the following problems:

- a. If a 115 v. electric motor draws 15 A. determine the cost of operating the motor for 6 hr. at 10¢/kwh.
- b. An electric heater with 8 ohm resistance draws 15 A. from service mains. What is the cost of operating the heater for 4 hours at 12¢/kwh?
- c. A current of 10 A. exists in a line with .15 ohm resistance. What is the production of heat in watts? At 10¢/kwh, what is the cost of the heat loss for 24 hours?
- d. If a VCR draws 2A. on a 110 v. line, calculate the power input in Joules developed in 30 sec.? Determine the cost of operating the VCR for 30 minutes at 12¢/kwh.

MICRO - PERFORMANCE OBJECTIVE #4

Understand Power in Thermal Systems

LEARNING STEPS

1. Define power in thermal system and relate thermal power to rate

2. Proceed to MPO #5

RESOURCES

1.
 - a. Read text pp. 137-140
 - b. View video: "Power in Thermal Systems"
 - c. Complete review activity sheet 6T1 in this learning guide. Obtain copies from instructor.

Principles of Technology
Review Activity Sheet 6T1

1. Explain how power in a thermal system may be defined as Work/Time.

2. How does power related to rate in a thermal system? Explain why.

MICRO - PERFORMANCE OBJECTIVE #5

Review summary - power

LEARNING STEPS

1. Review concept of power and its applications to each energy system
2. Determine task mastery
3. Proceed to Unit #7
Force Transformers

RESOURCES

1.
 - a. Read summary of power on pp. 143-5 in textbook
 - b. View video: "Summary, Power"
 - c. Complete unit review activity sheet in this learning guide
2. See instructor for Unit 6 post-test

Principles of Technology
Unit Activity Sheet - Power

1. Describe what is meant by "power" in each energy system.

mechanical- _____

fluid- _____

electrical- _____

thermal- _____

2. Explain how thermal power and thermal rate are the same. _____

3. Explain how the principle of Work/Time related to power in each energy system.

mechanical _____

fluid _____

electrical _____

thermal _____

4. Explain how power equals "Force" x RATE in mechanical, fluid, and electrical systems.

APPENDIX C

PRINCIPLES OF TECHNOLOGY

FINDINGS OF PILOT TEST

PRINCIPLES OF TECHNOLOGY

A. General Description

The Jo Daviess Carroll Area Vocational Center served as an official pilot site during 1984-85. Electronics students at the Stephenson Area Career Center also participated using individualized learning packets developed as a part of the ETE project. Students at both centers were essentially "volunteers" who utilized the materials in several different ways:

1. Spent two days per week on Principles of Technology and remaining three days in regular vocational program.
2. Spent one hour per two hour block working on Principles of Technology and one hour in regular vocational program.
3. Principles of Technology material was integrated into regular electronics/electricity program.

After some initial doubts those students who continued with the program were enthusiastic and would spend more than the allotted time on the Principles of Technology program. The initial reluctance would have been overcome with a better opportunity for student orientation.

In pilot test students varied widely in ability and math/science backgrounds. This ranged from no algebra/physical science to students having had Algebra II/Physics. Due to the small number and variety of students, statistical analysis of specific variables is not possible.

However, students pre and post test scores consistently showed a correlation with both ability and math/science backgrounds. Test scores usually demonstrated significant learning. Students at JDAVC and SACC are familiar with competency based learning and although the Principles of Technology was not offered on a strictly competency based delivery system, every effort was made to check for mastery prior to post testing. Students were encouraged to work as independently as possible with teacher discussions kept at a minimum. Students at SACC utilized the individualized learning guides very effectively and even JDAVC students utilized these guides to some extent as the year progressed. (See appendix B).

To further facilitate competency-based learning these learning guides could be further developed into "sub-unit" packets with student exercises, problem-solving applications, and more simplified, detailed laboratory instructions. The hands-on laboratory activities are an important part of the program and enhance student interest and learning.

B. Evaluation

1. Video: The video tapes were well received. Students were given open access to the tapes and often independently reviewed the tapes. In an individualized learning program, introduction and review material became very important.
2. Text: The text was adequate in terms of readability. In the preliminary form it was cumbersome but manageable. A glossary of terms would be useful.
3. Demonstrations: These were seldom used in our pilot tests. Students were allowed to review the material found in the teacher's manual regarding demonstrations. For the most part the demonstrations were a duplication of laboratory activities.
4. Laboratories: The labs are an important part of the program and took more time than allotted in the class schedule. The lack of equipment and make-shift efforts in getting the labs to work created problems. Problems with the laboratories have been carefully reviewed by the project staff and most will have been corrected for program implementation.

Students at the Jo Daviess Carroll Area Vocational Center and at SACC were expected to do the lab set-ups independently. This would be expected in the "open" competency based instructional system. In some cases students developed their own labs. Students not familiar with independent lab activities would probably not function as well. Students at SACC were sometimes required to do related "dry lab" exercises relating to the regular lab activities which proved to be an acceptable substitute when equipment was not available.

5. Student Evaluation: Grades given to students were based upon sub-unit quizzes, student exercises, daily performance points, and pre-post test comparisons. Students pre and post test scores are indicated separately at the end of this report.
6. Time allotment: Over-all the time allotments should be realistic. Because of the late start and equipment arrival, students at JDAVC were able to get through units 1-4. Students at SACC completed units 1-6 and unit 7 did not arrive until the school year was over. With planning it should be possible to maintain the recommended time sequence. In fact, all students working independently will need extra work or would be able to complete possibly ten or eleven units in one year. This cannot be fully determined until all of the Principles of Technology units are available.

C. Recommendations:

1. We do not feel that the Principles of Technology can be effectively integrated into vocational programs on a part time basis. It fragments the time and the program loses continuity. Ideally the Principles of Technology should be offered as a separate course. It is definitely a desirable prerequisite to technical vocational programs and could be offered in area vocational center feeder schools. To be effective, an effort should be made to include the Principles of Technology as a part of a sequential vocational program. Lack of sequential programming is a major stumbling block in the recruitment of students for technical training programs. The Principles of Technology provides part of the basic core for the development of an effective 2 + 2 program in electro-mechanical technology.
2. A teacher training program prior to implementation and a support system during implementation is very desirable. An in-service college credit course could be offered in connection with state colleges or universities. The in-service training would include such topics as organization, laboratories, and a review of the actual text materials, problems, and exercises. Quarterly meeting to discuss mutual problems and to exchange ideas could be held at various implementation sites with leadership and coordination provided by the training institution.
3. Participating in the pilot test of Principles of Technology has been challenging and rewarding. The program has tremendous potential but will need state leadership with implementation if this potential is to be fully utilized. The Principles of Technology provides a solid base for future technical training needs.

STEPHENSON AREA CAREER CENTER
PRINCIPLES OF TECHNOLOGY PILOT TEST SCORES

#	Math gr.pt.	Read gr.pt.	Unit 1		Unit 2		Unit 3		Unit 4		Unit 5		Unit 6	
			pre	post	pre	post	pre	post	pre	post	pre	post	pre	post
1.	7.6	10.7	12	21	--	--	--	--	--	--	--	--	--	--
2.	6.2	6.4	13	12	--	--	--	--	--	--	--	--	--	--
3.	6.0	5.0	11	11	12	29	17	27	17	15	15	16	8	7
4.*	12.0	10.7	21	21	20	22	15	--	--	--	--	--	--	--
5.	9.0	8.6	14	19	23	21	18	19	19	18	15	16	--	--
6.	7.8	7.9	13	24	17	30	16	24	21	33	21	29	15	27
7.*	9.7	12.7	23	25	28	28	23	25	29	39	Graduated 1/85		--	--
8.	5.6	8.8	17	25	--	--	--	--	--	--	--	--	--	--
9.	12.0	11.4	12	27	21	29	15	24	25	31	22	33	21	28
10.	10.0	10.0	18	21	--	--	--	--	--	--	--	--	--	--
11.	7.6	8.8	14	24	13	24	13	24	--	--	--	--	--	--
12.	8.4	12.7	15	21	18	24	17	18	21	25	17	23	14	13
13.	4.3	6.6	9	10	--	--	--	--	--	--	--	--	--	--
14.	6.0	10.0	18	19	13	18	13	16	--	--	--	--	--	--
15.	12.8	12.7	22	25	--	--	--	--	--	--	--	--	--	--
16.	5.6	7.0	16	19	--	--	--	--	--	--	--	--	--	--
17.*	13.4	12.7	13	19	19	19	20	--	--	--	--	--	--	--

It must be emphasized that students worked independently using prepared student learning guides. All students were required to do Unit I, but participation for the remaining units was totally voluntary. The scores above demonstrate the correlations between basic achievement, motivation, and ability although they are not statistically usable because of few students involved.

Students at the Jo Daviess Area Vocational Center volunteered to take the course but were subsequently expected to complete the course with an acceptable mastery level. Test scores for these students show consistent significant learning in each unit.

APPENDIX D

**TASK LISTINGS - AUTOMATED MANUFACTURING
(ELECTRO-MECHANICAL TECHNOLOGY)**

INTRODUCTION

The task lists presented here are intended to develop basic skills and knowledges which provide a foundation on which more advanced (post-secondary) training in automated production/robotics can be built.

Students who will be working from these task lists should enter the 11th grade with a firm background in mechanics, basic electricity, basic machining such as drilling, cutting, filing, and grinding supplemented with basic drafting and familiarization in reading technical manuals, flow charts, and blueprints. Math skills should include algebra if possible, measurements, and problem solving. Science skills should concentrate on the principles of physics. An appropriate program would be the Principles of Technology currently being developed and implemented nationwide.

Equipped with a comprehensive background in electronics, electrical/mechanical principles, fluid and pneumatic power systems, numerical control and computer applications, students will continue their training at the community college level. At the community college level, students will train in robotics systems analysis, systems applications, design and trouble shooting.

When completed, a task list continuum from the ninth grade will be developed which allows open entry/exit at any level at which the student identifies an interest or need for training. This task list would be used by instructors as an experience/mastery record as the student progresses through the program from feeder school, AVC, to the community college. Ideally future education/industry articulation will allow the task list to be expanded and incorporated into industry training and certification programs.

**ELECTRICITY/ELECTRONICS
PRINCIPLES OF TECHNOLOGY
TASK LIST**

TASK	TASK DESCRIPTION
900-908-001	Identify safety rules and practices in industrial electronics MPO: Identify safety rules for hand tools Identify laboratory and work safety Examine environmental hazards and preventive maintenance Identify safety rules and practices in industrial electronics
900-908-002	Explore the nature of electricity MPO: Explore electrical energy Explore the principles of electricity Explore the nature of electricity
900-908-004	Perform calculations using scientific notation MPO: Convert numbers into powers of 10 Convert numbers into decimals Convert numbers into prefixed form Add, subtract, divide and multiply powers of 10 Perform calculations using scientific notations
900-908-005	Identify voltage, current and resistance MPO: Explore conductance and conductors Explore resistors Explore conductors and resistors
900-908-006	Operate DC ammeter, voltmeter and ohmmeter MPO: Explore ammeters and voltmeters Explore an ohmmeter Operate a DC ammeter, voltmeter, and ohmmeter
900-908-007	Identify and compute electric power MPO: Explore power measurement and power dissipation Explore power ratings of loads and sources Identify and compute electric power
900-908-008	Solve ohm's law problems MPO: Explore ohms law Identify the milliamperes and microamperes Solve ohms law problem
900-908-009	Solve series and parallel circuit problems MPO: Explore series circuits Explore parallel circuits Solve series and parallel circuit problems

TASK	TASK DESCRIPTION
900-908-010	Solve Kirchoff's law problems MPO: Examine Kirchoff's law in a single loop Examine Kirchoff's law in parallel circuits Solve Kirchoff's law problems
900-908-011	Analyze magnetism and electromagnetism MPO: Explore a magnet Explore electromagnetism Analyze magnetism and electromagnetism
900-908-012	Measure AC waveforms, time periods, and frequencies on an oscilloscope MPO: Measure A.C. wave forms Measure time periods Measure frequencies
900-908-013	Perform investigation on parallel circuits MPO: Investigate parallel and compound circuits Investigate voltage and current measurements in parallel circuits Investigate parallel resistance and equal resistance in parallel
900-908-015	Solving Parallel Circuits MPO: Examine voltage, current, resistance, and power in parallel circuits Analyzing parallel circuits

**PRINCIPLES OF TECHNOLOGY
TASK LIST**

TASK DESCRIPTION

Acquire an understanding of capacitors and capacitive reactance

MPO: Identify properties of capacitance
Identify types of capacitors
Calculate effects of frequency and capacitive impedance
Solve circuits variables for capacitor and capacitive reactance

Measure and calculate voltage, current, resistance, power and phase relationship in RC circuits

MPO: Describe phase relationships in series RC circuits
Measure circuit parameters and calculate impedance in series RC circuits
Calculate power in series RC circuits
Measure circuit parameters and calculate impedance in parallel RC circuits

Acquire an understanding of inductors and inductive reactance

MPO: Describe electromagnetic properties
Describe the effects of an inductor on a changing
Describe with series and parallel circuit parameters with inductors
Analyze transformers parameters
Describe the effects of an inductor in a AC circuit
Describe the effects of series and parallel circuit inductors in AC circuit

Measure and calculate parameters in RL circuits

MPO: Calculate and measure phase relationship in series RL circuits
Calculate and measure phase relationships in parallel RL circuits
Calculate and measure compound RL circuits

Measure and calculate time constants in RC and RL circuits

MPO: Measure and calculate RC DC circuit charge cycles
Identify time constants using the universal time constants charts
Measure and calculate RL DC circuit charge cycles

Measure and calculate parameters in RLC circuits

MPO: Measure and calculate parameters in parallel reactive circuits
Measure and calculate parameters in parallel reactive circuits
Calculate and measure parameters in RLC circuits

PRINCIPLES OF TECHNOLOGY
TASK LIST

TASK DESCRIPTION

Measure and calculate parameters in resonant circuits

MPO: Describe the concept of resonance
Describe the bandwidth in series resonant circuits
Calculate and measure resonant frequency in parallel resonant circuits
Calculate and measure series and parallel resonant circuit parameters

Test and evaluate types of filters

MPO: Examine types of coupling
Test and evaluate low pass filters
Test and evaluate high pass filters
Test and evaluate band pass filters
Test and evaluate resonant filters

Use simple semiconductor diodes in basic circuits

MPO: Identify the structure and characteristics of semiconductor materials, as well as check for defective diodes
Construct power supplies and filters, measure their waveforms voltages, and currents

**PRINCIPLES OF TECHNOLOGY
TASK LIST**

TASK	TASK DESCRIPTION
900-970-210	Explore semiconductor diodes MPO: Explore the operation of a diode Explore diode applications Explore semiconductor diodes
900-970-211	Examine zener characteristics MPO: Explore the operating effects of a zener diodes Explore voltage regulation with zener diodes Examine zener diode characteristics
900-970-215	Examine diodes for special applications MPO: Explore tunnel and varactor diodes Explore high frequency diodes
900-970-218	Explore bipolar transistor operations MPO: Explore the basic principles of a bipolar transistor Identify basic transistor circuits Explore testing procedures for transistors
900-970-220	Explore bipolar transistor characteristics MPO: Explore common base circuits Explore common emitter circuits Explore common collector circuits
900-970-225	Explore field effect transistors MPO: Explore the junction F.E.T. Explore the insulated gate F.E.T.
900-970-228	Explore thyristor applications and characteristics MPO: Explore silicon controlled rectifiers Explore bidirectional triode thyristors Explore unijunction transistors
900-970-230	Examine integrated circuits MPO: Explore basic IC construction Examine applications of integrated circuits
900-970-235	Explore optoelectronic devices MPO: Explore the basic principles of light Explore light sensitive devices Explore light emitting devices

**PRINCIPLES OF TECHNOLOGY
TASK LIST**

TASK	TASK DESCRIPTION
900-970-300	Explore the basic concepts of digital techniques MPO: Explore the advantages and benefits of digital techniques Explore the binary number system Explore data representation
900-970-310	Explore semiconductor devices for digital circuits MPO: Explore bipolar transistor switches Design a saturated switch logic Explore the mos field effect transistors
900-970-315	Examine digital logic circuits MPO: Examine different types of logic circuits Explore decision-making logic elements Explore practical logic circuits
900-970-320	Examine integrated circuits MPO: Explore logic circuit characteristics Explore transistor-transistor logic Explore different logic operations
900-970-325	Define Boolean Algebra MPO: Relate digital logics with Boolean equations Minimize Boolean algebra
900-970-330	Explore Flip-Flops and registers MPO: Explore the functions of flip-flops Explore D type flip-flops and registers Explore JK flip-flops
900-970-335	Explore counters, shift registers and clocks MPO: Explore binary counters Explore BCD counters Explore shift registers Explore MOS shift registers Explore clock oscillator circuits
900-970-340	Explore combination logic circuits MPO: Explore decoders and encoders Explore multiplexers and demultiplexers Explore Rom construction and operation

**PRINCIPLES OF TECHNOLOGY
TASK LIST**

TASK	TASK DESCRIPTION
900-970-345	Examine digital designs MPO: Define a design problem Explore implementing and design procedures
900-970-350	Explore digital computers MPO: Explore digital test equipment Explore digital computer operations Explore digital computers

**PRINCIPLES OF TECHNOLOGY
TASK LIST**

TASK	TASK DESCRIPTION
900-970-400	Explore number systems and codes MPO: Explore the decimal and binary number system Explore the octal and hexadecimal number system Explore binary codes Explore number systems and codes
900-970-405	Explore microcomputer basic MPO: Explore terms and conventions Explore the microprocessor unit Examine the execution of a program Explore the addressing mode Explore microcomputer basics
900-970-410	Examine computer arithmetic MPO: Perform binary arithmetic Perform boolean operations Examine computer arithmetic
900-970-415	Introduction to programming MPO: Explore branching Explore conditional branching Explore algorithms Explore additional instructions Perform experiment on program branches Perform experiment on additional instructions
900-970-420	Explore the 6800 Microprocessor MPO: Explore the architecture of the 6800 MPU Explore the instruction set of the 6800 MPU Explore new addressing modes Perform experiment on new addressing modes Perform experiment on arithmetic operations
900-970-425	Explore stack operations of the 6800 microprocessor MPO: Explore stack operations Explore subroutines Explore input-output (I/O) operations Explore interrupts Perform experiment on stack operations Perform experiment on subroutines

**PRINCIPLES OF TECHNOLOGY
TASK LIST**

TASK	TASK DESCRIPTION
900-970-430	Explore semi conductor memories MPO: Explore interfacing fundamentals Explore interfacing with random access memory (RAM) Explore interfacing with displays Perform experiment on memory circuits Perform experiment on clocks Perform experiment on address decoding Perform experiment on data output
900-970-435	Designing with microprocessors MPO: Explore interfacing with switches Explore the peripheral interface adapter (PIA) Use the PIA Perform experiment on data input Perform experiment on introduction to the PIA Perform experiment on audio output Perform experiment on key matrix and parallel-to-series conversions Perform experiment on digital-to-analog and analog-to-digital conversions

MACHINE PRACTICE

900-941-001

IDENTIFY SAFE PRACTICES IN THE MACHINE SHOP

IDENTIFY SAFE PRACTICES IN THE MACHINE SHOP. GIVEN INFORMATION ON SAFETY YOU MUST SCORE 30 OUT OF 30 OR 100% ON A CRITERION EXAM TO MASTER THIS TASK.

- 1. PRACTICE PERSONAL SAFETY IN THE MACHINE SHOP**
- 2. PRACTICE GENERAL SAFETY IN THE MACHINE SHOP**
- 3. IDENTIFY SAFE PRACTICES IN THE MACHINE SHOP**

900-941-005

IDENTIFY AND LOCATE HAND TOOLS

GIVEN THE HAND TOOLS IN THE TOOL CRIB YOU MUST IDENTIFY THE TOOLS AND THEIR PROPER LOCATION IN THE TOOL CRIB WITH 90% ACCURACY, 27 OUT OF 36, ON A PERFORMANCE CHECKLIST AND COMPLETE A WRITTEN CRITERION EXAM ON THEIR USE WITH 90% ACCURACY OR 36 OUT OF 40 CORRECT.

- 1. IDENTIFY HAND TOOLS**
- 2. LOCATE HAND TOOLS**

900-941-055

IDENTIFY LAYOUT TOOLS

IDENTIFY LAYOUT TOOLS - GIVEN INFORMATION, PICTURES, AND TOOLS YOU MUST IDENTIFY AND DESCRIBE THESE TOOLS. YOU MUST SCORE 21 OUT OF 25 OR 85% ON THE CRITERION EXAM AND SCORE 16 OUT OF 19 OR 85% ON THE PRODUCT CHECKLIST TO MASTER THIS TASK.

- 1. DESCRIBE MEASURING TOOLS**
- 2. DESCRIBE LAYOUT TOOLS**
- 3. IDENTIFY LAYOUT TOOLS**

900-941-057

IDENTIFY AND USE SEMI-PRECISION MEASURING INSTRUMENTS

GIVEN SEMI-PRECISION MEASURING INSTRUMENTS AND WORKPIECES YOU WILL MEASURE THE WORKPIECES TO AN ACCURACY OF 1/64" AND SCORE AT LEAST 25 OUT OF 30 ON A PERFORMANCE/PRODUCT CHECKLIST FOR MASTERY YOU MUST ALSO SCORE 20 OUT OF 25 ON A WRITTEN CRITERION EXAM.

- 1. IDENTIFY MEASURING SYSTEMS**
- 2. IDENTIFY SEMI-PRECISION MEASURING INSTRUMENTS**
- 3. USE SEMI-PRECISION MEASURING INSTRUMENTS**

900-941-060

IDENTIFY AND USE DIAL INDICATORS

GIVEN DIAL INDICATORS, ACCESSORIES AND WORKPIECES YOU MUST SET-UP THE INDICATOR AND MEASURE WORKPIECES TO AN ACCURACY OF 1.001" AS SPECIFIED ON A PRODUCT CHECKLIST. FOR MASTERY OF THIS TASK YOU MUST SCALE AT LEAST 35 OUT OF 40 ON THE PRODUCT CHECKLIST AND 22 OUT OF 25 ON A WRITTEN CRITERION EXAM

1. IDENTIFY DIAL INDICATORS, THEIR SET-UP AND USE
2. USE DIAL INDICATORS

900-941-280

SET UP AND OPERATE A PEDESTAL GRINDER

GIVEN A PEDESTAL GRINDER, GRINDING WHEELS, WHEEL DRESSER, ATTACHMENTS AND WRENCHES, SAFELY SET UP AND OPERATE THE PEDESTAL GRINDER. TO MASTER THIS TASK YOU MUST PASS A WRITTEN CRITERION EXAM WITH 90% ACCURACY AND SCORE 90% ON A PERFORMANCE/PRODUCT CHECKLIST.

1. IDENTIFY PEDESTAL GRINDER SAFETY PROCEDURES
2. IDENTIFY THE PARTS AND CONTROLS OF THE PEDESTAL GRINDER
3. IDENTIFY, SELECT, AND MOUNT A GRINDING WHEEL
4. ADJUST THE TOOL REST AND EYE SHIELDS AND DRESS THE WHEEL

900-941-300

SET UP AND OPERATE A LATHE

GIVEN TWO TYPES OF ENGINE LATHES, PROCEDURE SHEET AND NECESSARY TOOLS, SET-UP AND OPERATE 2 TYPE OF LATHE UNDER SIMULATED CONDITIONS WITH AT LEAST 90 OUT OF 110 ON A PERFORMANCE/PRODUCT CHECKLIST AND 16 OUT OF 20 ON A WRITTEN CRITERION EXAM.

1. IDENTIFY LATHE SAFETY PROCEDURES
2. IDENTIFY THE PARTS AND CONTROLS OF A LATHE
3. DESCRIBE THE MAINTENANCE PROCEDURES FOR A LATHE
4. CALCULATE LATHE CUTTING SPEEDS, FEEDS AND TIME
5. IDENTIFY LATHE TOOL HOLDING DEVICES
6. IDENTIFY LATHE ACCESSORIES
7. SET-UP AND OPERATE A LATHE

900-941-240

SET UP AND OPERATE A DRILL PRESS

GIVEN A DRILL PRESS, TOOLS, WORK HOLDING DEVICES AND WORK ORDER SET UP AND OPERATE THE DRILL PRESS UNDER SIMULATED CONDITIONS. TO MASTER THIS TASK YOU MUST PASS A CRITERION EXAM WITH 80% ACCURACY OR 40 OUT OF 50 CORRECT AND COMPLETE A PERFORMANCE/PRODUCT CHECKLIST WITH 80% ACCURACY OR 32 OUT OF 40 POINTS CORRECT.

1. IDENTIFY DRILL PRESS SAFETY PRACTICES
2. IDENTIFY AN LOCATE DRILL PRESS TYPES, PARTS AND CONTROLS
3. IDENTIFY TOOL HOLDING DEVICES AND PROCEDURES
4. IDENTIFY WORK HOLDING DEVICES AND PROCEDURES
5. IDENTIFY DRILL BIT TYPES AND SIZES
6. IDENTIFY CUTTING FLUIDS
7. SELECT AND SET CUTTING SPEEDS AND FEEDS
8. SET UP AND OPERATE A DRILL PRESS

900-941-290

GRIND A LATHE TURNING TOOL

GIVEN A H.S.S. 5/16" SQUARE TOOL BIT, PEDESTAL GRINDER, AND NECESSARY HAND TOOLS THE STUDENT WILL GRIND A RIGHT HAND ROUND NOSE LATHE TURNING TOOL. TO MASTER THIS TASK YOU MUST PASS A WRITTEN CRITERION EXAM WITH 16 OUT OF 20 CORRECT AND SCORE 16 OUT OF 20 ON A PRODUCT CHECKLIST.

1. IDENTIFY CUTTING TOOL MATERIALS
2. IDENTIFY THE GEOMETRIC FORMS OF LATHE TOOLS
3. GRIND A RIGHT HAND ROUND NOSE LATHE TURNING TOOL

900-941-293

GRIND A LATHE THREADING TOOL

GIVEN A 5/16" SQUARE H.S.S. TOOL BLANK, YOU MUST GRIND A 60 DEGREE LATHE THREADING TOOL. TO MASTER THIS TASK, YOU MUST SCORE 10 OUT OF 12 OR 83% ON A PRODUCT CHECKLIST AND SCORE 6 OUT OF 7 OR 85% ON A WRITTEN CRITERION EXAM.

1. IDENTIFY 60 DEGREE THREADING TOOL GEOMETRY
2. GRIND A 60 DEGREE LATHE THREADING TOOL

900-941-294

SHARPEN A DRILL BIT

GIVEN THE DRILL SHARPENER, (DEREX), ACCESSORIES, HAND TOOLS, AND DRILL BIT, YOU MUST SHARPEN A DRILL BIT. YOU MUST SCORE 16 OUT OF 20 OR 80% ON THE CRITERION EXAM AND SCORE 13 OUT OF 15 OR 85% ON THE PRODUCT CHECKLIST TO MASTER THIS TASK.

1. IDENTIFY CONTROLS AND PARTS OF DEREX DRILL SHARPENER
2. SET-UP MACHINE AND DRILL FOR SHARPENING
3. SHARPEN A DRILL BIT

900-941-675

IDENTIFY THE PARTS AND CONTROLS OF A CNC LATHE

GIVEN A CNC LATHE, YOU WILL IDENTIFY THE PARTS AND CONTROLS OF A CNC LATHE. YOU MUST SCORE 9 OUT OF 10 OR 90% ON THE CRITERION EXAM, YOU MUST SCORE 16 OUT OF 19 OR 83% ON A PERFORMANCE CHECKLIST TO MASTER THIS TASK.

1. IDENTIFY CONTROL SWITCHES AND DISPLAY LIGHTS
2. IDENTIFY CONTROL BOARD FUNCTIONS
3. IDENTIFY KEYBOARD FUNCTIONS
4. IDENTIFY TOOL HOLDERS, WRENCHES, WORK HOLDING DEVICES, AND ATTACHMENTS
5. IDENTIFY THE PARTS AND CONTROLS OF A CNC LATHE

900-941-400

SET UP AND OPERATE A VERTICAL MILL

GIVEN TWO TYPES OF VERTICAL MILLING MACHINES, WORK ORDER, NECESSARY MATERIALS, TOOLING AND HAND TOOLS YOU WILL SET-UP AND OPERATE EACH MACHINE WITH 80% ACCURACY OR 44 OUT OF 55 ON A PERFORMANCE/PRODUCT CHECKLIST. YOU MUST ALSO COMPLETE A CRITERION EXAM WITH 80% ACCURACY OR 16 OUT OF 20 POINTS CORRECT.

1. IDENTIFY SAFETY PROCEDURES AND PRACTICES
2. IDENTIFY THE TYPES PARTS AND CONTROLS OF THE VERTICAL MILL
3. IDENTIFY MILLING CUTTERS AND TOOL HOLDING DEVICES
4. IDENTIFY WORK HOLDING DEVICES AND TECHNIQUES
5. CALCULATE PROPER FEEDS AND SPINDLE SPEEDS FOR MILLING OPERATIONS
6. EXPLORE CLIMB AND CONVENTIONAL MILLING
7. IDENTIFY THE DEPTH OF CUT
8. IDENTIFY TECHNIQUES USED IN TROUBLESHOOTING SET-UPS
9. PERFORM BASIC MILLING MACHINE MAINTENANCE
10. SET-UP AND OPERATE A VERTICAL MILL

900-941-402

SET UP AND OPERATE A HORIZONTAL MILL

GIVEN A HORIZONTAL MILL, WORK ORDER, NECESSARY MATERIALS, TOOLING, AND HAND TOOLS YOU MUST SET-UP AND OPERATE THE MACHINE. TO MASTER THIS TASK YOU MUST SCORE 64 OUT OF 80 OR 80% ON A PRODUCT CHECKLIST AND SCORE 24 OUT OF 30 OR 80% ON A WRITTEN CRITERION EXAM.

1. IDENTIFY SAFETY PROCEDURES
2. IDENTIFY THE TYPES, PARTS AND CONTROLS OF THE HORIZONTAL MILL
3. IDENTIFY MILLING CUTTERS
4. IDENTIFY WORK HOLDING DEVICES AND TECHNIQUES
5. CALCULATE FEEDS AND SPEEDS FOR MILLING OPERATIONS
6. PERFORM BASIC MILLING MACHINE MAINTENANCE
7. USE THE HORIZONTAL MILL
8. SET UP AND OPERATE THE HORIZONTAL MILL

900-941-408

MACHINE A MILLING TEST BLOCK

GIVEN A VERTICAL MILL, BLUEPRINT, NECESSARY TOOLS AND EQUIPMENT, YOU WILL PERFORM THE FOLLOWING OPERATIONS: FLAT SURFACE MILLING, SLOT, POCKET AND ANGLE MILLING, DRILLING AND REAMING HOLES. ALL OPERATIONS MUST BE TO PRINT SPECIFICATIONS WITH 50 OUT OF 62 OR 80% CORRECT ACCORDING TO A PRODUCT CHECKLIST. YOU MUST ALSO COMPLETE A WRITTEN CRITERION EXAM WITH 16 OUT OF 20 OR 80% CORRECT.

1. MILL THE PART SQUARE TO BLUEPRINT SPECIFICATIONS
2. LAYOUT THE WORKPIECE
3. DRILL AND REAM HOLES
4. PERFORM FLAT SURFACE MILLING
5. PERFORM SLOT AND POCKET MILLING
6. PERFORM ANGLE MILLING

HYDRAULICS/PNEUMATICS

900-950-105 IDENTIFY THE PRINCIPLES OF HYDRAULICS

GIVEN THE INFORMATION IN THIS LEARNING GUIDE IDENTIFY THE PRINCIPLES OF HYDRAULICS BY ANSWERING 13 OF 15 ITEMS CORRECT ON THE CRITERION EXAM.

1. IDENTIFY THE LAWS OF FLUID POWER
2. IDENTIFY AREA FORCE
3. IDENTIFY THE NATURE OF FLUIDS
4. IDENTIFY THE PRINCIPLES OF HYDRAULICS

900-950-110 IDENTIFY HYDRAULIC SYSTEMS

GIVEN THE INFORMATION IN THIS LEARNING GUIDE IDENTIFY HYDRAULIC SYSTEMS BY ANSWERING 9 OF 10 ITEMS CORRECT ON A CRITERION EXAM.

1. IDENTIFY COMPONENTS AND THEIR RELATIONSHIP IN A HYDRAULIC SYSTEM
2. IDENTIFY MECHANICAL SET UP
3. IDENTIFY HYDRAULIC SYSTEMS

900-950-125 TROUBLESHOOT HYDRAULIC SYSTEM

GIVEN THE INFORMATION CONTAINED IN THIS LEARNING GUIDE YOU MUST PASS A CRITERION EXAM ON THE PROCEDURE TO TROUBLESHOOT HYDRAULIC SYSTEMS WITH 15 OF 17 ITEMS CORRECT.

1. DEFINE COMPONENT RELATIONSHIPS
2. ANALYZE PRESSURE AND FLOW
3. ESTABLISH A LOGICAL TROUBLESHOOTING SEQUENCE
4. TROUBLESHOOT HYDRAULIC SYSTEMS

900-950-130 INSTALL HYDRAULIC COMPONENTS

GIVEN THE INFORMATION CONTAINED IN THIS LEARNING GUIDE YOU WILL PASS A CRITERION EXAM BY SCORING 11 OF 12 ITEMS CORRECT ON THE CONSIDERATIONS TO PROPERLY INSTALL HYDRAULIC COMPONENTS.

1. IDENTIFY INSTALLATION CLEANLINESS AND SAFETY OF HYDRAULIC COMPONENTS.
2. IDENTIFY PUMP AND DRIVE INSTALLATION.
3. IDENTIFY THE INSTALLATION OF CONTROL, MECHANICAL, PNEUMATIC AND ELECTRICALLY OPERATED VALVES.
4. INSTALL HYDRAULIC COMPONENTS.

900-950-190 IDENTIFY PUMPS

GIVEN THE INFORMATION CONTAINED IN THIS LEARNING GUIDE YOU WILL IDENTIFY PUMPS ON A CRITERION EXAM BY SCORING 13 OF 16 ITEMS CORRECT.

1. IDENTIFY PUMP APPLICATION AND SELECTION.
2. IDENTIFY THE PRINCIPLES AND CLASSIFICATION OF CERTIFIED PUMPS.
3. IDENTIFY THE OPERATING PRINCIPLES OF ROTARY PUMPS.
4. IDENTIFY THE OPERATING PRINCIPLES OF RECIPROCATING PUMPS.

5. IDENTIFY SPECIAL SERVICE PUMPS
6. IDENTIFY PUMPS

900-950-180 IDENTIFY, TROUBLESHOOT, AND REPAIR HYDRAULIC CYLINDERS

GIVEN A HYDRAULIC CYLINDER AND TOOLS, YOU WILL TROUBLESHOOT AND REPAIR CYLINDERS. TO MASTER THIS TASK YOU MUST SCORE 20 OUT OF 22 POINTS OR 90% ON A PERFORMANCE CHECKLIST, AND PASS A CRITERION EXAM BY RECEIVING 10 OUT OF 12 POINTS OR 80%.

1. EXPLAIN THE USE OF HYDRAULIC CYLINDERS.
2. IDENTIFY COMPONENTS OF PISTON CYLINDER.
3. IDENTIFY COMPONENTS OF VANE CYLINDERS.
4. MAINTAIN HYDRAULIC CYLINDERS.
5. TROUBLESHOOT & REPAIR HYDRAULIC CYLINDERS.

900-950-305 IDENTIFY PNEUMATIC PRINCIPLES

GIVEN THE INFORMATION IN THIS LEARNING GUIDE IDENTIFY PNEUMATIC PRINCIPLES BY ANSWERING 9 OF 10 ITEMS CORRECT ON THE CRITERION EXAM.

1. DIFFERENTIATE BETWEEN FORCE, WEIGHT, MASS, WORK AND ENERGY.
2. IDENTIFY PNEUMATIC LAWS.
3. IDENTIFY PROPERTIES OF AIR.
4. IDENTIFY PNEUMATIC PRINCIPLES.

900-950-350 IDENTIFY PNEUMATIC SYSTEMS

GIVEN THE INFORMATION IN THIS LEARNING GUIDE IDENTIFY PNEUMATIC SYSTEMS BY ANSWERING 9 OF 10 ITEMS CORRECT ON A CRITERION EXAM.

1. IDENTIFY COMPONENTS AND THEIR RELATIONSHIP IN A PNEUMATIC SYSTEM.
2. IDENTIFY AIR SUPPLY SYSTEM.
3. IDENTIFY DELIVERED AIR SYSTEM.
4. IDENTIFY PNEUMATIC SYSTEMS.

900-950-355 INSTALL PNEUMATIC COMPONENTS

GIVEN THE INFORMATION CONTAINED IN THIS LEARNING GUIDE YOU WILL PASS A CRITERION EXAM ON HOW TO INSTALL PNEUMATIC COMPONENTS AND SCORE 9 OF 10 ON A CRITERION EXAM.

1. IDENTIFY INSTALLATION OF COMPRESSOR AND AUXILIARIES
2. IDENTIFY INSTALLATION OF PIPE, TUBING AND HOSES.
3. IDENTIFY INSTALLATION OF CONTROL SYSTEMS AND ACTUATORS.
4. INSTALL PNEUMATIC COMPONENTS.

900-950-360

TROUBLESHOOT PNEUMATIC SYSTEMS

GIVEN THE INFORMATION CONTAINED IN THIS LEARNING GUIDE, YOU MUST PASS A CRITERION EXAM ON THE PROCEDURE TO TROUBLESHOOT PNEUMATIC SYSTEMS WITH 13 OF 15 ITEMS CORRECT.

1. DEFINE COMPONENT RELATIONSHIPS.
2. IDENTIFY PROBLEMS IN TERMS OF PRESSURE AND FLOW.
3. ESTABLISH A LOGICAL TROUBLESHOOTING SEQUENCE.
4. TROUBLESHOOT PNEUMATIC SYSTEMS.

900-950-370

TROUBLESHOOT PNEUMATIC CONTROL VALVES

GIVEN THE INFORMATION CONTAINED IN THIS LEARNING GUIDE YOU WILL TROUBLESHOOT PNEUMATIC CONTROL VALVES BY SCORING 12 OF 13 ITEMS CORRECT ON A CRITERION EXAM.

1. TROUBLESHOOT A NON-STARTING OR INOPERATIVE CIRCUIT.
2. TROUBLESHOOT IMPROPER SEQUENCING OF CIRCUIT.
3. TROUBLESHOOT MISCELLANEOUS PROBLEMS RELATED TO EQUIPMENT.
4. TROUBLESHOOT PNEUMATIC CONTROL VALVES.

900-950-035

PERFORM MAINTENANCE ON STRAINERS, FILTERS AND TRAPS

GIVEN STRAINER, FILTERS, TRAPS, AND TOOLS, PERFORM MAINTENANCE ON STRAINERS, FILTERS, AND TAPS, AND RECEIVE 26 OF 42 POINTS ON A PERFORMANCE CHECKLIST FOR STRAINERS AND 42 OR 45 ON A PERFORMANCE/PRODUCT CHECKLIST FOR STEM TRAPS, AND THEN PASS A CRITERION EXAM WITH 8 OUT OF 10 ITEMS CORRECT.

1. IDENTIFY APPLICATIONS OF STRAINERS, FILTERS, AND TRAPS.
2. PERFORM MAINTENANCE ON STRAINERS, FILTERS, AND TRAPS.

900-950-025

IDENTIFY METALLIC TUBING

GIVEN A CRITERION EXAM IDENTIFY METALLIC TUBING AND RECEIVE 8 OF 10 ITEMS CORRECT.

1. IDENTIFY ADVANTAGES OF METALLIC TUBING.
2. IDENTIFY TUBING APPLICATION AND MAINTENANCE.
3. CUT COPPER TUBING AND INSTALL FITTING.
4. IDENTIFY METALLIC TUBING.

900-950-020

IDENTIFY NON-METALLIC PIPING

GIVEN A CRITERION EXAM, IDENTIFY NON METALLIC PIPE WITH 8 OF 10 ITEMS CORRECT.

1. IDENTIFY NON METALLIC MATERIALS AND PIPE.
2. IDENTIFY LIMITATIONS AND MAINTENANCE OF NON METALLIC PIPE.
3. CUT PVC PIPE AND INSTALL FITTINGS.
4. IDENTIFY NON METALLIC PIPING.

900-950-017

INSULATE PIPE

GIVEN A PIPING SYSTEM YOU WILL INSULATE THE PIPE AND RECEIVE 24 OF 27 POINTS ON A PRODUCT CHECKLIST.

1. IDENTIFY PIPE INSULATION.
2. INSULATE PIPE.

900-950-010

IDENTIFY PIPING SYSTEMS

YOU WILL IDENTIFY PIPING SYSTEMS ON A CRITERION EXAM WITH 8 OF 10 CORRECT.

1. IDENTIFY PIPING SYSTEMS AND FLUIDS
2. IDENTIFY PIPING SYSTEM MAINTENANCE
3. IDENTIFY PIPE HANGERS AND SUPPORTS
4. INSULATE PIPE
5. IDENTIFY PIPING SYSTEMS

900-950-016

THREAD PIPE

GIVEN THE OPPORTUNITY TO SELECT TOOLS, MATERIALS, EQUIPMENT, AND WITHOUT THE USE OF A REFERENCE YOU WILL THREAD 3/4" & 1" PIPE BY HAND AND 1/2" TO 2" PIPE BY MACHINE AND RECEIVE 17 OF 19 POINTS ON A PRODUCT CHECKLIST.

1. IDENTIFY PIPE THREADING AND TOOLS.
2. CUT, REAM, AND THREAD PIPE BY HAND.
3. CUT, REAM AND THREAD PIPE BY MACHINE.
4. THREAD PIPE.

900-950-015

IDENTIFY METAL PIPING

GIVEN THE INFORMATION YOU HAVE GAINED FROM THIS SLG IDENTIFY METAL PIPING AFTER PASSING A CRITERION EXAM WITH 8 OF 10 ITEMS CORRECT AFTER RECEIVING 22 OF 22 POINTS ON A PRODUCT CHECKLIST.

1. IDENTIFY PIPE SCHEDULES AND TYPES OF METAL PIPE.
2. IDENTIFY CHARACTERISTICS AND MAINTENANCE OF METAL PIPE.
3. IDENTIFY METHODS OF JOINING PIPE.
4. IDENTIFY METAL PIPING.